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published in
Labour Economics
2018

DOI (link to publisher)
10.1016/j.labeco.2018.05.004

document version
Publisher's PDF, also known as Version of record

document license
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Labour Economics 53 (2018) 198–212

Contents lists available at ScienceDirect

Labour Economics

journal homepage: www.elsevier.com/locate/labeco

Labor market imperfections, markups and productivity in multinationals and exporters☆

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ARTICLE INFO

MSC:
C23
D24
F14
F16
J50
L13

Keywords:
Rent sharing
monopsony
price-cost mark-ups
productivity
exporting
multinational firms
panel data

ABSTRACT

This paper examines the links between a firm's internationalization status and the type and degree of market imperfections in product and labor markets. We develop a framework for modelling heterogeneity across firms in terms of (i) product market power (price-cost markups), (ii) labor market imperfections (workers' bargaining power during worker-firm negotiations or a firm's degree of wage-setting power) and (iii) revenue productivity. We apply this framework to analyze whether the pricing behavior of firms in product and labor markets differs across firms that engage in different forms of internationalization using an unbalanced panel of 7,458 manufacturing firms over the period 1994-2012 in Japan. Engagement in international activities is found to matter for determining not only the type of imperfections in product and labor markets but also the degree of imperfections. Clear differences in behavior between firms that serve the foreign market either through exporting or through FDI are observed. Exporters are more likely to be characterized by imperfect competition in the product market whereas the opposite holds for multinationals. Exporters are more likely to share rents based on the bargaining power of workers whereas a firm's wage-setting power seems to generate wage dispersion across firms with foreign subsidiaries.

1. Introduction

During the past decades, the relationship between globalization and wages has been at the center of debate in industrialized countries. A growing theoretical literature emphasizes trade-induced variation in firm-specific wages as one of the main drivers of increased wage inequality.

Building on a Melitz (2003)-type trade model, there exist various heterogeneous-firms approaches to trade and wage inequality which all draw on imperfect factor markets but differ in terms of the rent-sharing mechanism between workers and firms that generate inter-firm wage dispersion even with ex ante identical workers. In spite of the growing importance of labor market imperfections in theoretical trade models, no empirical study has so far investigated how product and labor market imperfections vary across firms that differ in terms of engagement in international activities. This paper serves the purpose of examining heterogeneity in product and labor market imperfections across exporters, non-exporters, multinational enterprises (MNEs) and non-MNEs.

We contribute to the econometric literature on identifying firm-specific market imperfections and the empirical international trade literature along various dimensions. Our first contribution is a methodological one. We develop an econometric framework that allows for three-dimensional firm heterogeneity: product market power (price-cost markups), labor market imperfections (workers' bargaining power during worker-firm negotiations or a firm's degree of wage-setting power) and revenue total factor productivity (TFP). Rather than following standard practice and imposing a particular imperfect labor market model on the data, we let the data determine the type of competition prevailing in product and labor markets. We accomplish this by

☆ We gratefully acknowledge the insightful comments and suggestions by the Editor and two anonymous referees. We also benefited from useful discussions with Antonio Accetturo, Boris Hirsch, Fukunari Kimura, Jacques Mairesse, Lionel Nesta, Toshihiro Okubo, Stefano Schiavo and other participants at various conferences and seminars. This study was conducted as part of the project "Microeconometric analysis of firm and industry growth" undertaken at the Research Institute of Economy, Trade and Industry (RIETI). The empirical analysis uses micro data from the questionnaire in the Basic Survey of Japanese Business Structure and Activities, which is conducted by the Ministry of Economy, Trade and Industry (METI). Kiyota gratefully acknowledges financial support from the Japan Society for the Promotion of Science (JSPS), Grant-in-Aid (JP16H02018, JP18H03637) and the MEXT-Supported Program for the Strategic Research Foundation at Private Universities.

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https://doi.org/10.1016/j.labeco.2018.05.004
Received 1 November 2017; Received in revised form 25 April 2018; Accepted 11 May 2018
Available online 12 May 2018

building on the econometric reduced-form productivity model with imperfect product and labor markets which has been developed in and Dobbelaere and Mairesse (2013). As such, we derive product and labor market imperfection parameters and regression-based TFP measures from estimating microeconomic production functions. Dobbelaere and Mairesse (2013) consider a Cobb-Douglas production technology and use the parametric generalized method of moments approach, which relies on instrumental variables, to obtain consistent estimates of industry-specific product and labor market imperfection parameters. We assume a flexible functional form of the production function (translog) and employ the semiparametric structural control function approach, that uses observed variables and economic theory to invert out productivity non-parametrically, in order to get consistent estimates of product and labor market imperfections and TFP at the firm-year level.

The theoretical structural productivity model behind the econometric reduced-form productivity model nests two polar models of wage determination in imperfect labor markets in the seminal productivity model of Hall (1988) which allows to estimate price-cost markups: the strongly efficient bargaining model (one of the two canonical collective bargaining models; McDonald and Solow, 1981) allocates market power to employees through costs of firing, hiring and training while the static partial equilibrium monopsony model (Manning, 2003) allocates market power to employers through allowing workers to have heterogeneous preferences over workplace environments of different potential employers, which generates upward-sloping labor supply curves to individual firms.

The second contribution is to apply our econometric framework to analyze the type and the degree of product and labor market imperfections in firms that differ in terms of internationalization, while accounting for differences in revenue productivity. To accomplish this, we use an unbalanced panel of 7,458 manufacturing firms in Japan covering the period 1994-2012. As such, our analysis aims at improving our understanding of the wage determination process in firms that engage differently in international activities through discerning whether either market power on the supply side of labor or market power on the demand side of labor is predominantly responsible for driving a wedge between labor's estimated marginal revenue product and its measured payment. To examine the link between the internationalization status of firms and the *type* of competition prevailing in product and labor markets, we estimate (two-equation) probit models. To examine the relationship between export/foreign direct investment (FDI) behavior and the *degree* of product and labor market imperfections, we apply OLS regression techniques.

Our main findings are summarized as follows. First, we find that engagement in international activities matters for determining the type as well as the degree of imperfections in product and labor markets. Second, we observe clear differences in behavior between firms that serve the foreign market either through exporting or through FDI. Such contrasting findings suggest that the two major modes of globalization, trade and FDI, have quite different consequences on firms' market power.

More precisely, focusing on differential impacts on the type of imperfections in the product market, we find that being an exporter increases the likelihood of being characterized by imperfect competition in the product market, even after controlling for productivity differences. This result might be explained by either differences in quality or differences in demand elasticities and income across domestic and export markets. In contrast, firms engaging in FDI are less likely to be characterized by imperfect competition in the product market, even after controlling for productivity differences between MNEs and non-MNEs. Strategies of dumping and transfer pricing exerting opposite effects on markups than channels of quality and demand elasticity differences could explain this result. On the labor market side, we find that exporting firms are more likely to share rents based on the bargaining power of workers, but less likely to share rents based on the elasticity of the labor supply curve facing an individual employer. Strikingly, the opposite finding holds for MNEs: a firm's wage-setting power rather than workers' bargaining power appears to generate wage dispersion across firms engaging in FDI. This differential form of firm-worker rent sharing across exporters and MNEs matches with expectations. Exporting firms, charging higher markups and realizing higher rents, might be willing to share part of these rents with their workers according to a surplus-sharing rule, thereby increasing market power on the labor supply side. Intra-firm competition in multinationals, triggered by the threat to transfer production, R&D or some other tasks to a competing subsidiary, is likely to increase intra-firm labor replacement. As such, MNEs could have considerable monopsony power in the labor market, implying that market power could be consolidated on the labor demand side.

Focusing on differential impacts on the degree of imperfections, we find that export status appears to be positively correlated with both product market power (markups) and market power consolidated on the labor supply side (workers' bargaining power). Interestingly, export status is positively correlated with the wage elasticity of a firm's labor supply curve. This indicates that exporting firms are less able to exploit wage-setting power. In contrast, a negative correlation is observed between MNE status and either markups or workers' bargaining power. The latter result could be explained by the fact that offshoring could increase substitution between domestic and foreign workers. This might in turn flatten the labor demand curve and shift bargaining power over rent distribution from labor towards capital in MNEs.

The plan of the article is as follows. Section 2 provides a review of the relevant theoretical literature and main empirical findings from which we derive conjectures about the relationships of interest. Section 3 presents the main ingredients of the theoretical structural productivity model with imperfect product and labor markets. Section 4 discusses our econometric model and the estimation procedure. Section 5 presents the Japanese firm panel data. Section 6 examines how the type of competition prevailing in product and labor markets varies across firms that differ in terms of engagement in international activities. Section 7 investigates potential links between internationalization and firms' degree of product and labor market imperfections. Section 8 concludes.

2. Synopsis of related literature

2.1. Internationalization status and market imperfections

Let us first summarize why pricing behavior might vary across firms that differ in terms of internationalization status based on existing theoretical literature and most relevant empirical findings.

Following an approach pioneered by Hopenhayn (1992) and Krugman (1980), the Melitz (2003) model of international trade is characterized by firm heterogeneity in productivity and fixed export costs, and monopolistic competition and generates trade-induced shifts in the productivity distribution through selection of efficient firms into exporting and inefficient firms into exit. This model does not provide a model of income distribution as workers are symmetrically affected by trade liberalization because the labor market is frictionless and all workers are identical.

A recent theoretical literature on heterogeneous firms and trade has paid attention to the interaction between firms' selection and labor markets. These various heterogeneous-firms approaches consider imperfect labor markets that feature firm-worker rent sharing to be the key but differ in the precise mechanism that ties firm wages to firm performance. A first approach considers fair wages (Amiti and Davis, 2011; Egger and Kreickemeier, 2009) or efficiency wages (Davis and Harrigan, 2011) as a source of labor market imperfections, with productivity-specific wages resulting from a fair-wage effort mechanism in the former and different monitoring technologies in the latter. A second approach focuses on search and matching frictions such that ex-post bargaining over the surplus of production can potentially induce wages to vary with revenue across firms (Coşar et al., 2016; Davidson et al., 2008;

Fajgelbaum, 2013; Felbermayr et al., 2011; Helpman et al., 2010). A third approach considers firm-level unionization as a source of labor market imperfections, with decentralized collective bargaining producing inter-firm wage disparities (Montagna and Nocco, 2013). To the best of our knowledge, theories incorporating heterogeneous firms, imperfect labor markets and FDI is limited to Egger and Kreickemeier (2013) who build on Melitz (2003) and develop a general equilibrium two-country model in which national firms and horizontal multinational firms coexist and firm-level rent sharing results from fair wage preferences of workers.

Whereas the assumption of constant elasticity of substitution consumer demand in Melitz (2003)-type models ensures constant firm price-cost markups, there is a large class of models that account for variable price-cost markups by imposing some assumptions on demand and market structure. Seminal papers are Bernard et al. (2003), Melitz and Ottaviano (2008) and Zhelobodko et al. (2012), who develop heterogeneous-firms models with variable markups, which allow prices and markups to be affected by firm entry and market size.[1] Rather than modelling productivity differences as producing a symmetric variety at lower marginal cost, Crozet et al. (2012) model higher productivity as producing a higher quality variety at equal cost, building on Melitz (2003) and Baldwin and Harrigan (2007). In addition to these efficiency and quality channels, markup differences between exporters and domestic firms might be explained by a demand elasticity channel or by income differences across markets. Following a standard price discrimination argument, exporters can charge different prices between domestic and export markets because domestic and export markets are segmented by trade costs. Also, exporters might charge higher prices on richer markets where consumers' willingness to pay is higher. Whereas these three channels predict a positive relationship between export status and markups, a dumping strategy might work in the opposite direction. Behrens et al. (2014) develop a general equilibrium model of monopolistic competition with heterogeneous firms, variable demand elasticity and multiple asymmetric regions, in which wages and markups are endogenous and show that exporters could charge lower markups because of tougher selection in the market.

In contrast to exports, to the best of our knowledge, theoretical research on the relationship between FDI and firm markups is nonexistent. Given that, since Helpman et al. (2004), investment in foreign markets is usually considered to be the following step (after exports) in the internationalization process, the same four underlying channels could shape the relationship between MNE status and markups. Importantly, an additional channel might come into play, that is, transfer pricing behavior. MNEs encountering differing tax schedules might have an incentive to shift profits to low-tax countries by altering transfer prices (Copithorne, 1971; Horst, 1971).[2]

On the empirical side, we can classify microeconometric studies testing some of the predictions of the aforementioned models in several groups. A first set of papers has established empirical support for Melitz's selection effect, i.e. the positive relationship between a firm's export or MNE status and its productivity level. Helpman (2006) and Bernard et al. (2007, 2012) review empirical evidence on the positive exporter productivity premium and Temouri et al. (2008) on the positive MNE productivity premium.

A second set of papers has provided evidence of the theoretical conjecture that reductions in trade costs lead to a positive correlation between exports/FDI and wages. For example, exploiting a trade liberalization episode in Indonesia, Amiti and Davis (2011) show that a decrease in output tariffs raises wages of workers in exporting firms (see Carluccio and Bas, 2015; Harrison et al., 2011; Schank et al., 2007; Wagner, 2012 for other references on evidence of exporter wage premia). Malchow-Møller et al. (2013) and Konings et al. (2016) review evidence of MNE wage premia, which –in imperfectly competitive labor market settings– can be explained by fair wages concerns, the need to coordinate wages across borders through rent sharing, efficiency wages to induce effort and reduce shirking, or upward-sloping labor supply curves.

A third set of papers has empirically investigated the relationship between export status and price-cost markups. Most papers have provided evidence of a positive relationship which is either generated by heterogeneity on the supply side (technical efficiency differences, see e.g. De Loecker and Warzynski, 2012; Kato, 2014) or by heterogeneity on the demand side (quality differences, see e.g. Bellone et al., 2016; Crozet et al., 2012; Hallak and Sivadasan, 2013). Exploiting actual trade liberalization episodes in India and China, De Loecker et al. (2016), Brandt et al. (2017) and Fan et al. (2018) estimate the causal effect of trade reforms on firm markups. They confirm that cost-reducing effects of trade liberalization give firms a strong incentive to raise markups. Manova and Zhang (2012) provide empirical evidence on exporters charging higher prices in richer destinations. Only very few studies have focused on the empirical relationship between MNE status and markups. For example, Sembenelli and Siotis (2008) disentangle the efficiency (positive knowledge spillover) and competition channels of foreign presence on markups and find a negative short-run correlation between foreign presence and markups but a positive long-run correlation for firms in knowledge-intensive industries. Although direct evidence of the impact of transfer pricing on markups is nonexistent, evidence of transfer pricing is provided by Vicard's (2015) and Cristea and Nguyen (2016). Davies et al. (2018) show that the intensity of profit shifting is greater for large MNEs.

Imposing a particular rent-sharing mechanism on the data, a fourth set of papers has investigated the relationship between openness and labor market imperfections. Fabbri et al. (2003) and Görg et al. (2009) provide evidence of multinationals having higher labor demand elasticities than domestic firms, hence, validating Rodrik (1997) hypothesis that increased globalization has increased labor demand elasticities through substitutability of domestic by foreign workers, thereby weakening workers' bargaining power. Following this line of reasoning, several studies have relied on a collective bargaining framework in a closed-economy setting to show evidence of a relationship between international trade and workers' bargaining power using either firm panel data (e.g. Brock and Dobbelaere, 2006; Dumont et al., 2006; Abraham et al. 2009; Boulhol et al. 2011; Ahsan and Mitra 2014) or matched employer-employee data (e.g. Felbermayr et al., 2014).

Based on the argument that rent sharing may be conditioned by international linkages, Budd and Slaughter (2004) extend the collective bargaining framework to an open-economy setting and provide evidence of profits being shared across borders within multinational firms (see also Budd et al., 2005). Martins and Yang (2015) confirm their findings for a much wider set of parent-affiliate pairs, including parents and affiliates in Japan. They show that international rent sharing, i.e. parents sharing profits with foreign affiliates, is higher when affiliates are located in low-tax countries, which they interpret as evidence of transfer pricing.[3]

[1] Bernard et al. (2003) introduce Bertrand competition into Eaton and Kortum's (2002) probabilistic model of comparative advantage. Extending Melitz (2003), Melitz and Ottaviano (2008) develop a monopolistically competitive model with quasi-linear preferences. Zhelobodko et al. (2012) build a model of monopolistic competition with variable costs and preferences over differentiated products being additively separable across varieties.

[2] Transfer pricing is the practice whereby multinationals can manipulate reported profits of parents and affiliates by choosing the prices used to record intrafirm transfers of, e.g., intellectual property or intermediate inputs. Many countries' tax laws explicitly try to minimize this practice, but to the extent that it occurs, the measured parent and affiliate profits may differ from the true values.

[3] Whereas these studies focus on a post-acquisition environment, Konings et al. (2016) investigate how rent sharing changes before and af-

Relying on a search-and-matching framework, Davidson et al. (2014) show that openness improves the matching between workers and firms using matched employer-employee data, while Lu et al. (2017) exploit exogenous changes in China's inward FDI regulations and estimate the causal impact of liberalization of inward FDI on a firm's monopsony power using firm panel data. They find that inward FDI liberalization has increased employers' wage-setting power whereas a negative correlation is found between a firm's export status and its wage-setting power.

2.2. Testable conjectures

As explained in the following Sections, the type of product market imperfections (or the product market setting, denoted PMS) is either perfect competition (PC) or imperfect competition (IC). This simple dichotomy is based on the price-cost markup, i.e. either no market power or market power. As such, firms charging price-cost markups exceeding one are characterized by PMS = IC. The type of labor market imperfections (or the labor market setting, denoted LMS) is either perfect competition or right-to-manage bargaining (PR), efficient bargaining (EB) or monopsony (MO). Intuitively, a firm in which the marginal employee receives a real wage equal to her marginal product is characterized by LMS = PR whereas a firm in which the marginal employee is paid a real wage exceeding (lower than) her marginal product is characterized by LMS = EB (LMS = MO).

Let us now draw conjectures about the relationship between export/MNE status and the type and the degree of product and labor market imperfections from the available theories and empirical analyses in the existing literature.

Theoretically, channels operating in opposite directions (efficiency, quality, demand elasticity and income channel versus increased competition) make the relationship between exporters and markups ambiguous. The same holds for the relationship between MNEs and markups, in which case transfer pricing practices reinforce the dumping strategy (competitive) effect.

The vast majority of empirical studies provide evidence on a positive relationship between exporters and markups. This finding, coupled with the fact that the corporate income tax rate in Japan was the highest among the OECD during our sample period (Hasegawa and Kiyota, 2017) lead us to postulate the following testable conjectures.

Conjecture 1a: Exporters are likely to operate in an imperfectly competitive product market setting.

Conjecture 1b: Multinationals are less likely to operate in an imperfectly competitive product market setting.

Conjecture 2a: Export status is positively correlated with price-cost markups.

Conjecture 2b: MNE status is not positively correlated with price-cost markups.

Available theoretical and empirical research does not prove informative when it comes to postulating a relationship between the internationalization status of firms and the type of labor market imperfections for the following reasons. First, a unified theoretical framework in which the precise rent-sharing mechanism is modelled as an explicit decision by individual firms is non-existent and heterogeneous-firms approaches to trade and wage inequality take a stand on a specific model of imperfectly competitive labor markets. Second, empirical studies providing evidence on the relationship between globalization and labor market imperfections impose a precise form of firm-worker rent sharing on the data. Based on indirect empirical evidence on exporters being more likely to sign firm-level collective bargaining agreements by Carluccio and Bas (2015), empirical evidence on multinationals perceiving higher labor demand elasticities and the possibility of Japanese MNEs engaging in international rather than domestic rent sharing as part of a transfer pricing strategy, we derive the following conjectures.

Conjecture 3a: Exporters are likely to operate in a collective bargaining labor market setting.

Conjecture 3b: Multinationals are less likely to operate in a collective bargaining labor market setting.

Conjecture 4a: Export status is positively correlated with workers' bargaining power.

Conjecture 4b: MNE status is not positively correlated with workers' bargaining power.

3. Theoretical structural productivity model with imperfect product and labor markets

A firm i at time t produces output using the following production technology:

$$Q_{it} = Q_{it}(N_{it}, M_{it}, K_{it}) \tag{1}$$

with (N_{it}, M_{it}) a vector of static inputs in production free of adjustment costs (labor and intermediate inputs) and K_{it} capital treated as a dynamic input in production (predetermined in the short run).

We assume that (*i*) $Q_{it}(\cdot)$ is continuous and twice differentiable with respect to its arguments, (*ii*) a firm takes the input price of materials as given[4] and (*iii*) producers active in the market are maximizing short-run profits.

Let us turn to the firm's short-run profit maximization problem. Firm i's short-run profits, Π_{it}, are given by:

$$\Pi_{it} = R_{it} - W_{it}N_{it} - J_{it}M_{it} \tag{2}$$

with $R_{it} = P_{it}Q_{it}$ an increasing and concave revenue function, P_{it} the output price and W_{it} and J_{it} the firm's input prices for N and M, respectively, at time t.

Firm i must choose the optimal quantity of output and the optimal demand for intermediate inputs and labor. The optimal output choice Q_{it} satisfies the following first-order condition:

$$\frac{P_{it}}{(C_Q)_{it}} = \left(1 + \frac{s_{it}\kappa_{it}}{\eta_t}\right)^{-1} = \mu_{it} \tag{3}$$

with $(C_Q)_{it} = \frac{\partial C_{it}}{\partial Q_{it}}$ the marginal cost of production, $s_{it} = \frac{Q_{it}}{Q_t}$ the market share of firm i, η_t the own-price elasticity of market demand, κ_{it} a conjectural variations parameter and μ_{it} firm i's price-cost markup.[5]

ter a foreign takeover and how wages in the target company are determined by domestic and international rent sharing.

[4] This assumption might be perceived as being restrictive, given that around one-third of total trade takes place within multinational firms' boundaries and that trade in finished products is being gradually outpaced by trade in intermediates (Hummels et al., 2001). We defend our restrictive assumption on two grounds. The first is a data reason. Conditional on introducing a third freely adjustable input factor (by, e.g., splitting M_{it} into raw materials and components, and energy), our static productivity model could be extended to accommodate imperfect competition in the intermediate input market by modelling such imperfections as additional unit costs that create wedges between marginal costs and marginal products. However, data constraints preclude us from considering this choice. The second reason is that we prefer to focus our empirical analysis on investigating differences in pricing behavior in output and labor markets, abstaining from the input sourcing choice of multinationals. For theoretical work on a firm's optimal choice of outsourcing to unaffiliated suppliers versus integrating input production and the firm itself, we refer, e.g., to Defever and Toubal (2013) and Carluccio et al. (2015) who build on the incomplete contracts approach to the theory of the firm, and Garetto (2013) who develops a general equilibrium framework. The former also empirically investigate the role of firm-specific observables in affecting a firm's outsourcing decision.

[5] If firms produce a homogeneous good and play Nash in quantities (Cournot competition), the price-cost markup $\mu_{it} = \frac{P_t}{(C_Q)_{it}}$ would be equal to $\left(1 + \frac{s_{it}}{\eta_t}\right)^{-1}$, with P_t the price of the homogeneous good at time t and $\eta_t = \frac{\partial Q_t}{\partial P_t}\frac{P_t}{Q_t}$ the own-price elasticity of market demand. If firms produce a differentiated good and

The first-order condition for the optimal choice of intermediate inputs is given by setting the marginal revenue product of intermediate inputs equal to the price of intermediate inputs:

$$(Q_M)_{it} = \mu_{it}\frac{J_{it}}{P_{it}} \tag{4}$$

Inserting Eq. (3) in Eq. (4) and multiplying both sides by $\frac{M_{it}}{Q_{it}}$ yields:

$$(\varepsilon_M^Q)_{it} = \mu_{it}s_{Mit} \tag{5}$$

From Eq. (5), it follows that profit maximization implies that optimal demand for intermediate inputs is satisfied when a firm equalizes the output elasticity with respect to intermediate inputs, denoted by $(\varepsilon_M^Q)_{it} = \frac{\partial Q_{it}}{\partial M_{it}}\frac{M_{it}}{Q_{it}}$, to the price-cost mark-up μ_{it} multiplied by the share of intermediate input expenditure in total sales, denoted by $s_{Mit} = \frac{J_{it}M_{it}}{P_{it}Q_{it}}$.

Firm i's optimal demand for labor depends on the characteristics of its labor market. We distinguish three labor market settings: perfect competition or right-to-manage bargaining (PR), strongly efficient bargaining (EB) and static partial equilibrium monopsony (MO).

Under PR, labor is unilaterally determined by firm i from short-run profit maximization, which implies the following first-order condition:

$$(\varepsilon_N^Q)_{it} = \mu_{it}s_{Nit} \tag{6}$$

with $(\varepsilon_N^Q)_{it} = \frac{\partial Q_{it}}{\partial N_{it}}\frac{N_{it}}{Q_{it}}$ the output elasticity with respect to labor and $s_{Nit} = \frac{W_{it}N_{it}}{P_{it}Q_{it}}$ the share of labor expenditure in total sales. In the perfectly competitive labor market model, a firm takes the exogenously-determined market wage as given. A profit-maximizing firm always chooses employment such that the marginal revenue product of labor equals the wage (Eq. (6)). In the right-to-manage bargaining model, the firm and its workers bargain over any surplus in order to determine the wage (Nickell and Andrews, 1983). The firm continues to choose the number of workers it wishes to employ once wages have been determined by the bargaining process, which implies the same static first-order condition for labor as in the perfectly competitive labor market model.

Under EB, the risk-neutral firm and its risk-neutral workers negotiate simultaneously over wages and employment in order to maximize the joint surplus of their economic activity (McDonald and Solow, 1981). An efficient wage-employment pair is obtained by maximizing a generalized Nash product[6] with respect to the wage rate and labor. The following first-order condition with respect to wages must hold at an interior optimum:

$$W_{it} = \overline{W}_{it} + \gamma_{it}\left[\frac{R_{it} - W_{it}N_{it} - J_{it}M_{it}}{N_{it}}\right] \tag{7}$$

where $\gamma_{it} = \frac{\phi_{it}}{1-\phi_{it}}$ is the relative extent of rent sharing and $\phi_{it} \in [0, 1]$ the part of economic rents going to the workers.

The first-order condition for labor is given by:

$$W_{it} = (R_N)_{it} + \phi_{it}\left[\frac{R_{it} - (R_N)_{it}N_{it} - J_{it}M_{it}}{N_{it}}\right] \tag{8}$$

with $(R_N)_{it} = \frac{\partial R_{it}}{\partial N_{it}}$ the marginal revenue product of labor.

An efficient wage-employment pair is given by solving simultaneously the first-order conditions with respect to the wage rate and labor. As such, the equilibrium condition is given by:

$$(R_N)_{it} = \overline{W}_{it} \tag{9}$$

Eq. (9) traces out the locus of efficient wage-employment pairs, known as the contract curve. Given that $\mu_{it} = \frac{P_{it}}{(R_Q)_{it}}$ in equilibrium, with $(R_Q)_{it} = \frac{\partial R_{it}}{\partial Q_{it}}$ the marginal revenue, we obtain the following expression for the output elasticity with respect to labor by combining Eqs. (7) and (9):

$$(\varepsilon_N^Q)_{it} = \mu_{it}s_{Nit} - \mu_{it}\gamma_{it}(1 - s_{Nit} - s_{Mit}) \tag{10}$$

So far, we have assumed that there is a potentially infinite supply of employees wanting a job in the firm. A small wage cut by the employer will result in the immediate resignation of all existing workers. However, under MO, the labor supply facing an individual employer might be less than perfectly elastic because workers might have heterogeneous preferences over workplace environments of different potential employers (Manning, 2003). Such heterogeneity in e.g. firm location or job characteristics (corporate culture, starting times of work) makes workers to view employers as imperfect substitutes. This in turn gives employers non-negligible market power over their workers.

Let us assume that the monopsonist firm is constrained to set a single wage for all his workers and faces labor supply $N_{it}(W_{it})$, which is an increasing function of the wage W. Both $N_{it}(W_{it})$ and the inverse of this relationship $W_{it}(N_{it})$ are referred to as the labor supply curve of this firm. The monopsonist firm's objective is to maximize its short-run profit function $\Pi_{it} = R_{it} - W_{it}(N_{it})N_{it} - J_{it}M_{it}$, taking the labor supply curve as given. Maximizing this profit function with respect to labor gives the following first-order condition:[7]

$$(R_N)_{it} = (W_N)_{it}N_{it} + W_{it}(N_{it}) \tag{11}$$

Rewriting Eq. (11) gives:

$$W_{it} = \beta_{it}(R_N)_{it} \tag{12}$$

with $\beta_{it} = \frac{W_{it}}{(R_N)_{it}} = \frac{(\varepsilon_W^N)_{it}}{1+(\varepsilon_W^N)_{it}}$. $\beta_{it} \leq 1$ represents the wage markdown and $(\varepsilon_W^N)_{it} = \frac{\partial N_{it}(W_{it})}{\partial W_{it}}\frac{W_{it}}{N_{it}} \in \Re_+$ the wage elasticity of the labor supply curve that firm i faces, measuring the degree of wage-setting power that firm i possesses. Perfect competition corresponds to the case where $\left(\varepsilon_W^N\right)_{it} = \infty$, hence $\left(R_N\right)_{it} = W_{it}$. Under monopsony, $(\varepsilon_W^N)_{it}$ is finite and the labor supply curve that firm i faces is upward sloping, hence, the firm sets $W_{it} < (R_N)_{it}$. As such, the degree of firm i's wage-setting power decreases in the wage elasticity of its labor supply curve.

Rewriting Eq. (12) and using that $(R_N)_{it} = \frac{P_{it}(Q_N)_{it}}{\mu_{it}}$ with $(Q_N)_{it}$ the marginal product of labor, gives the following expression for the elasticity of output with respect to labor:

$$(\varepsilon_N^Q)_{it} = \mu_{it}s_{Nit}\left(1 + \frac{1}{(\varepsilon_W^N)_{it}}\right) \tag{13}$$

Using the first-order condition for intermediate inputs, we obtain an expression for firm i's price-cost markup (μ_{it}) and using the first-order conditions for intermediate inputs and labor, we define firm i's parameter of product and labor market imperfections (ψ_{it}), which we label firm i's joint market imperfections parameter, as follows:

$$\mu_{it} = \frac{(\varepsilon_M^Q)_{it}}{s_{Mit}} \tag{14}$$

play Nash in prices (Bertrand competition), the price-cost markup $\mu_{it} = \frac{P_{it}}{(C_Q)_{it}}$ would be equal to $\left(1 + \frac{1}{\eta_{it}}\right)^{-1}$, with η_{it} a firm's own-price elasticity of residual demand.

[6] The generalized Nash product is written as: $\Omega_{EB} = \left\{N_{it}W_{it} + \left(\overline{N}_{it} - N_{it}\right)\overline{W}_{it} - \overline{N}_{it}\overline{W}_{it}\right\}^{\phi_{it}}\left\{R_{it} - W_{it}N_{it} - J_{it}M_{it}\right\}^{1-\phi_{it}}$ with $\overline{N}_{it}$ the competitive employment level, $\overline{W}_{it}$ the workers' alternative wage and $\phi_{it} \in [0,1]$ the part of economic rents going to the workers or the degree of workers' bargaining power during worker-firm negotiations.

[7] From Eq. (11), it follows that profit maximization implies that the optimal demand for labor is satisfied when a firm equalizes the marginal revenue product of labor to the marginal cost of labor. The latter is higher than the wage paid to the new worker $W_{it}(N_{it})$ by the amount $(W_N)_{it}N_{it}$ because the firm has to increase the wage paid to all workers it already employs whenever it hires an extra worker.

$$\psi_{it} = \frac{(\varepsilon_M^Q)_{it}}{s_{Mit}} - \frac{(\varepsilon_N^Q)_{it}}{s_{Nit}} \tag{15}$$

$$= 0 \quad \text{if LMS} = \text{PR} \tag{16}$$

$$= \mu_{it}\gamma_{it}\left[\frac{1 - s_{Nit} - s_{Mit}}{s_{Nit}}\right] > 0 \quad \text{if LMS} = \text{EB} \tag{17}$$

$$= -\mu_{it}\frac{1}{(\varepsilon_W^N)_{it}} < 0 \quad \text{if LMS} = \text{MO} \tag{18}$$

4. Econometric model

In order to obtain consistent estimates of the output elasticities $(\varepsilon_N^Q)_{it}$ and $(\varepsilon_M^Q)_{it}$, we only consider production functions with (*i*) a scalar Hicks-neutral productivity term which is observed by the firm but unobserved by the econometrician (denoted by ω_{it}) and (*ii*) common technology parameters, governing the transformation of inputs to units of output, across a set of producers (denoted by the vector β). These two assumptions imply the following expression for the production function:

$$Q_{it} = F(N_{it}, M_{it}, K_{it}; \boldsymbol{\beta}) \exp(\omega_{it}) \tag{19}$$

In order to obtain consistent estimates of the production function coefficients (β) for each of the 15 two-digit industries that we consider (see infra), we need to control for unobserved productivity shocks ω_{it}, which are potentially correlated with the firm's input choices. We apply the estimation procedure proposed by Ackerberg et al. (2015) using the insight that optimal input choices hold information about unobserved productivity. We denote the logarithms of Q_{it}, N_{it}, M_{it} and K_{it} by q_{it}, n_{it}, m_{it} and k_{it}, respectively.

We impose the following timing assumptions. Capital k_{it} is assumed to be decided a period ahead (at $t-1$) because of planning and installation lags. Labor is "less variable" than material. More precisely, n_{it} is chosen by firm i at time $t-b$ $(0<b<1)$, after k_{it} being chosen at $t-1$ but prior to m_{it} being chosen at t. This assumption is consistent with firms needing time to train new workers, with firms facing significant hiring or firing costs for labor, or with labor contracts being long term as e.g. in unionized firms/industries.

We assume that unobservable productivity (ω_{it}) evolves according to an endogenous first-order Markov process. In particular, we allow a firm's decision to import to endogenously affect future productivity, which is supported by evidence in international economics applications (see e.g. Amiti and Konings, 2007; Halpern et al., 2015; Kasahara and Rodrigue, 2008). The intuition behind this assumption is that importing is associated with higher firm productivity through access to more varieties of intermediate inputs, access to higher quality inputs, and through learning effects. As such, we can decompose ω_{it} into its conditional expectation given the information known by the firm in $t-1$ (denoted I_{it-1}) and a random innovation to productivity (denoted ξ_{it}):

$$\begin{aligned}\omega_{it} &= \mathrm{E}[\omega_{it}|I_{it-1}] + \xi_{it} \\ &= \mathrm{E}[\omega_{it}|\omega_{it-1}, IMP_{it-1}] + \xi_{it} \\ &= g(\omega_{it-1}, IMP_{it-1}) + \xi_{it}\end{aligned} \tag{20}$$

with IMP_{it-1} the import status of firm i at period $t-1$ and $g(\cdot)$ a general function. ξ_{it} is assumed to be mean independent of the firm's information set at $t-1$.

Given these timing assumptions, firm i's intermediate input demand at t depends directly on n_{it} chosen prior to m_{it}, i.e. the input demand function for m_{it} is conditional on n_{it}:[8]

$$m_{it} = m_t(n_{it}, k_{it}, IMP_{it}, \omega_{it}) \tag{21}$$

Eq. (21) shows that firm i's intermediate input demand decision is a function of the state variables n_{it}, k_{it}, IMP_{it} and ω_{it}. It is crucial that ω_{it} is the only unobservable entering the intermediate input demand function. This scalar unobservable assumption together with the assumption that $m_t(\cdot)$ is strictly increasing in ω_{it} conditional on n_{it}, k_{it} and IMP_{it} (strict monotonicity assumption),[9] allow to invert ω_{it} as a function of observables:

$$\omega_{it} = m_t^{-1}(m_{it}, n_{it}, k_{it}, IMP_{it}) \tag{22}$$

Considering the logarithmic version of Eq. (19) and allowing for an idiosyncratic error term including non-predictable output shocks and potential measurement error in output and inputs (ϵ_{it}) gives:

$$y_{it} = f(n_{it}, m_{it}, k_{it}; \boldsymbol{\beta}) + \omega_{it} + \epsilon_{it} \tag{23}$$

where $y_{it} = q_{it} + \epsilon_{it}$ with ϵ_{it} assumed to be mean independent of current and past input choices.[10]

We approximate $f(\cdot)$ by a second-order polynomial where all logged inputs, logged inputs squared and interaction terms between logged inputs are included (translog production function):

$$\begin{aligned}y_{it} = {}& \beta_0 + \beta_n n_{it} + \beta_m m_{it} + \beta_k k_{it} + \beta_{nn} n_{it}^2 + \beta_{mm} m_{it}^2 + \beta_{kk} k_{it}^2 + \beta_{nm} n_{it} m_{it} \\ & + \beta_{nk} n_{it} k_{it} + \beta_{mk} m_{it} k_{it} + \omega_{it} + \epsilon_{it}\end{aligned} \tag{24}$$

where β_0 has to be interpreted as the mean efficiency level across firms.

Substituting Eq. (22) in Eq. (24) results in a first-stage equation of the form:

$$y_{it} = f_{it} + m_t^{-1}(m_{it}, n_{it}, k_{it}, IMP_{it}) + \epsilon_{it} = \varphi_t(n_{it}, k_{it}, m_{it}, IMP_{it}) + \epsilon_{it} \tag{25}$$

which has the purpose of separating ω_{it} from ϵ_{it}, i.e. eliminating the portion of output y_{it} determined by unanticipated shocks at time t, measurement error or any other random noise (ϵ_{it}).

Hence, the first stage involves using Eq. (25) and the moment condition $\mathrm{E}[\epsilon_{it}|I_{it}] = 0$, with I_{it} the firm's information set at t, to obtain an estimate $\hat{\varphi}_{it}$ of the composite term $\varphi_t(n_{it}, k_{it}, m_{it}, IMP_{it}) = f_{it} + m_t^{-1}(m_{it}, n_{it}, k_{it}, IMP_{it})$, which represents output net of ϵ_{it}. In our application, estimation of Eq. (25) is implemented by regressing output on a second-order polynomial series expansion where all logged inputs, logged inputs squared and interaction terms between logged inputs are included. To allow for time variation in φ_t, these polynomial terms are interacted with a time trend.

Given a particular set of parameters $\boldsymbol{\beta}$, we can compute (up to a scalar constant) an estimate of ω_{it}:

$$\begin{aligned}\hat{\omega}_{it}(\boldsymbol{\beta}) &= \hat{m}_t^{-1}(m_{it}, n_{it}, k_{it}, IMP_{it}) \\ &= \hat{\varphi}_{it} - \beta_0 - \beta_n n_{it} - \beta_m m_{it} - \beta_k k_{it} - \beta_{nn} n_{it}^2 - \beta_{mm} m_{it}^2 - \beta_{kk} k_{it}^2 \\ &\quad - \beta_{nm} n_{it} m_{it} - \beta_{nk} n_{it} k_{it} - \beta_{mk} m_{it} k_{it}\end{aligned} \tag{26}$$

[8] By allowing for observed shifters (here IMP_{it}) that enter the optimal demand function for m_{it}, but are excluded from the production function, we solve the non-identification problem of the output elasticity with respect to materials and, hence, are in a position to apply the control function approach for the estimation of a gross output production function (see Gandhi et al., 2017). Intuitively, the non-identification problem would arise under $m_{it} = m_t(n_{it}, k_{it}, \omega_{it})$, because in that case, the only intermediate input demand shifter aside from the other inputs in the production function would be ω_{it}. As the elasticity of output with respect to intermediate inputs is identified with how output varies with m_{it}, holding fixed (n_{it}, k_{it}), the only source of variation in m_{it} (namely ω_{it}) would also simultaneously shift output, causing the elasticity of output with respect to materials to be unidentified.

[9] Melitz and Levinsohn (2006) show that this strict monotonicity assumption holds as long as more productive firms do not set inordinately higher markups than less productive firms.

[10] Note that $(\varepsilon_N^Q)_{it} = \frac{\partial \ln F(\cdot)}{\partial \ln N_{it}}$ and $(\varepsilon_M^Q)_{it} = \frac{\partial \ln F(\cdot)}{\partial \ln M_{it}}$. These output elasticities are by definition independent of a firm's productivity shock.

In order to implement the second stage and to identify the production function coefficients, we need to recover the innovation to productivity ξ_{it} to form moments on. Using Eq. (26), a consistent (non-parametric) approximation to $E[\omega_{it}|\omega_{it-1}, IMP_{it-1}]$ is given by the predicted values from regressing nonparametrically $\hat{\omega}_{it}(\boldsymbol{\beta})$ on $\hat{\omega}_{it-1}(\boldsymbol{\beta})$ and IMP_{it-1}. The residual from this regression provides us with an estimate of ξ_{it}.

Given the timing assumptions on input use, the following population moment conditions can be defined: $E[\xi_{it}(\beta)\mathbf{d}] = 0$ where the set of instruments is:

$$\mathbf{d}_{it} = \left\{n_{it-1}, m_{it-1}, k_{it}, n_{it-1}^2, m_{it-1}^2, k_{it}^2, n_{it-1}m_{it-1}, n_{it-1}k_{it}, m_{it-1}k_{it}\right\} \tag{27}$$

Exploiting these moment conditions, we can now estimate the production function coefficients $\boldsymbol{\beta}$ using standard GMM and rely on block bootstrapping for the standard errors. The estimated production function coefficients $\hat{\boldsymbol{\beta}}$ are then used together with data on inputs to compute the output elasticities at the firm-year level. In particular, we calculate the elasticity of output with respect to labor at the firm-year level as:

$$(\hat{\varepsilon}_N^Q)_{it} = \hat{\beta}_n + 2\hat{\beta}_{nn}n_{it} + \hat{\beta}_{nm}m_{it} + \hat{\beta}_{nk}k_{it} \tag{28}$$

Similarly, we calculate the elasticity of output with respect to material at the firm-year level as:[11]

$$(\hat{\varepsilon}_M^Q)_{it} = \hat{\beta}_m + 2\hat{\beta}_{mm}m_{it} + \hat{\beta}_{mn}n_{it} + \hat{\beta}_{mk}k_{it} \tag{29}$$

Using the shares of labor and intermediate input expenditure in total sales, s_{Nit} and s_{Mit}, respectively, and our estimates of the output elasticities, $(\hat{\varepsilon}_N^Q)_{it}$ and $(\hat{\varepsilon}_M^Q)_{it}$, we are able to compute $\hat{\mu}_{it}$ and $\hat{\psi}_{it}$. Since we only observe $Y_{it} = Q_{it}\exp(\epsilon_{it})$, we do not observe the correct expenditure shares for N_{it} and M_{it}. We can recover an estimate of ϵ_{it} from the first stage to adjust the expenditure shares as follows:[12]

$$\hat{s}_{Nit} = \frac{W_{it}N_{it}}{P_{it}\frac{Y_{it}}{\exp(\hat{\epsilon}_{it})}} \tag{30}$$

$$\hat{s}_{Mit} = \frac{J_{it}M_{it}}{P_{it}\frac{Y_{it}}{\exp(\hat{\epsilon}_{it})}} \tag{31}$$

Using Eqs. (28)–(31), we compute $\hat{\mu}_{it}$ and $\hat{\psi}_{it}$ as follows:

$$\hat{\mu}_{it} = \frac{(\hat{\varepsilon}_M^Q)_{it}}{\hat{s}_{Mit}} \tag{32}$$

$$\hat{\psi}_{it} = \frac{(\hat{\varepsilon}_M^Q)_{it}}{\hat{s}_{Mit}} - \frac{(\hat{\varepsilon}_N^Q)_{it}}{\hat{s}_{Nit}} \tag{33}$$

Based on the estimates $\hat{\mu}_{it}$ and $\hat{\psi}_{it}$, we are able to determine the product market setting PMS $\in$ {PC,IC} and the labor market setting LMS $\in$ {PR,EB,MO} of firm i at time t and hence, firm i's regime of competitiveness R $\in \Re$ = { PC-PR,IC-PR,PC-EB,IC-EB,PC-MO,IC-MO} at time t as follows. We first compute the 95% two-sided confidence intervals (CI) for μ_{it} and $gap_{Nit} = \frac{(\varepsilon_N^Q)_{it}}{\hat{s}_{Nit}}$.

- 95% confidence interval for μ_{it}:

$$\left[\hat{\mu}_{it} - 1.96\times\hat{\sigma}_{\hat{\mu}_{it}}, \hat{\mu}_{it} + 1.96\times\hat{\sigma}_{\hat{\mu}_{it}}\right] = \left[A_{\hat{\mu}_{it}}, B_{\hat{\mu}_{it}}\right] \tag{34}$$

with $\hat{\sigma}_{\hat{\mu}_{it}}$ the standard error of $\hat{\mu}_{it}$, which is an estimator of the standard deviation of the sampling distribution of $\hat{\mu}_{it}$.
- 95% confidence interval for gap_{Nit}:

$$\left[\widehat{gap}_{Nit} - 1.96\times\hat{\sigma}_{\widehat{gap}_{Nit}}, \widehat{gap}_{Nit} + 1.96\times\hat{\sigma}_{\widehat{gap}_{Nit}}\right] = \left[A_{\widehat{gap}_{Nit}}, B_{\widehat{gap}_{Nit}}\right] \tag{35}$$

with $\hat{\sigma}_{\widehat{gap}_{Nit}}$ the standard error of $\widehat{gap}_{Nit}$.

To determine firm i's PMS at time t, we use the 95% CI for μ_{it}:

- If the lower bound of the 95% CI ($A_{\hat{\mu}_{it}}$) is lower than or equal to unity, firm i is characterized to be perfectly competitive (PC) at time t.
- If $A_{\hat{\mu}_{it}}$ exceeds unity, firm i is characterized by imperfect competition (IC) at time t.

To determine firm i's LMS at time t, we compare the 95% CIs for gap_{Nit} and μ_{it}. In particular, firm i

- is characterized by perfect competition/right-to-manage bargaining (PR) at time t if the 95% CIs for gap_{Nit} and μ_{it} overlap which implies that $\hat{\mu}_{it}$ is not significantly different from $\widehat{gap}_{Nit}$, hence $\hat{\psi}_{it} = 0$ at the 5% significance level.
- is characterized by efficient bargaining (EB) at time t if $A_{\hat{\mu}_{it}} > B_{\widehat{gap}_{Nit}}$, hence $\hat{\psi}_{it} > 0$ at the 5% significance level.
- is characterized by monopsony (MO) at time t if $A_{\widehat{gap}_{Nit}} > B_{\hat{\mu}_{it}}$, hence $\hat{\psi}_{it} < 0$ at the 5% significance level.

Once firm i's regime at time t is determined, we are able to quantify market power in product and labor markets. As explained in Section 3, the product and labor market imperfection parameters are derived from the estimated joint market imperfections parameter $\hat{\psi}_{it}$ and their respective standard errors are computed using the Delta method (Wooldridge, 2002).

5. Data

Our data come from the Basic Survey of Japanese Business Structure and Activities (BSJBSA) compiled by the Ministry of Economy, Trade, and Industry (METI) in Japan. The purpose of this survey is to capture an overall picture of Japanese corporate activities, including globalization and diversification, as well as basic corporate characteristics, including sales, costs, profits, employment, assets and debt. The survey is compulsory for firms with more than 50 employees and with capital of more than 30 million yen in both manufacturing and some service industries such as wholesale trade, retail trade, and information and communication. In this study, we focus on manufacturing firms only.

In the BSJBSA, an industry classification code is assigned to each firm based on their main activities. For example, let us assume that a firm engages in both manufacturing and wholesale trade activities. If its largest revenue comes from manufacturing activities, the firm is classified as a manufacturing firm. This implies that manufacturing firms do not necessarily engage in manufacturing activities only. Some firms switch from one industry to another during the sample period. Although switching behavior of firms is an important issue, each firm is assigned to the industry to which it belongs most frequently during our sample period.

The variables involved in our regression analyses are defined and measured in the following way. Output (Q) is defined as real gross output measured by nominal sales divided by an industry-wide gross output price index. Labor (N) refers to the average number of permanent workers. Material input is defined as intermediate consumption deflated by an industry-wide intermediate consumption price index. The capital stock (K) is measured by the real capital stock computed from tangible assets and investment based on the perpetual inventory method. The price deflators are obtained from the Japan Industrial Productivity (JIP) 2014 database, which was compiled by RIETI and Hitotsubashi University.[13] The shares of labor (s_N) and material input (s_M) are constructed by dividing respectively the firm total labor cost and undeflated intermediate consumption by the firm undeflated production. The cost of capital is defined as the user cost of capital times the real capital stock. The user cost of capital is computed from the investment goods price deflator times the sum of the interest rate and the depreciation rate minus changes in the investment goods price. In addition, we use the firm's

[11] Under a Cobb–Douglas production function, $(\varepsilon_N^Q)_{it}$ and $(\varepsilon_M^Q)_{it}$ would be equal to $\hat{\beta}_n$ and $\hat{\beta}_m$, respectively.

[12] This correction is important as it eliminates any variation in expenditure shares that comes from variation in output not correlated with $\varphi_t(\cdot)$.

[13] For more details on the JIP database, see Fukao et al. (2007).

age and its share of non-production workers as controls in the regression models, where the latter is defined as the ratio of non-production workers to total employees. We calculate the Herfindahl-Hirschman index (*HHI*) at the industry-year level to obtain a measure of market concentration.

We first deleted firm-year observations with cost shares greater than or equal to one and smaller than or equal to zero. In order to remove outliers, we also disregarded firm-year observations with cost shares in the bottom 1% and top 1% of the respective industry-year distributions. We selected firms that survive at least two consecutive years because lagged inputs are needed to construct moment conditions in our estimation framework. We obtain an unbalanced estimation sample consisting of 64,481 observations for 7,458 firms over the years 1994-2012, which we decompose into 15 two-digit industries.[14] Table A.1 in Appendix reports the panel structure of the estimation sample. Table A.2 reports the number of observations and firms by industry.

In addition to standard firm accounting information and the control variables mentioned above, the BSJBSA also provides information on firms' export and import behavior and foreign direct investment. A firm reporting positive exports is classified as an exporter. Multinational enterprises consist of two types of firms: foreign-owned firms and Japanese firms that engage in FDI. A foreign-owned firm is defined as a firm with a foreign capital share greater than 50% and with headquarters located outside of Japan. A firm that has at least one foreign affiliate is regarded as a firm engaging in FDI.[15] As reported in Hoshi (2018), Japan is known to have an exceptionally low share of foreign-owned firms, which is confirmed in our sample: only 1% of firms engages in inward FDI.

From Table A.2 in Appendix, it follows that a minority of firms within an industry export and/or have networks of foreign affiliates: the overall share of manufacturing firms that export is 25% and 16% of firms are identified as MNEs. 46% of exporters are MNEs and 73% of MNEs are exporting. There is considerable variation in export market participation rates and in the importance of FDI as a mode of serving the foreign market across manufacturing industries. In particular, the share of exporters ranges from only 6% in wood, wooden products and furniture to 50% in chemicals. Likewise, the share of MNEs ranges from only 4% in pulp, paper and paper products to 27% in chemicals. The shares of exporting and importing firms are significantly positively correlated across industries. Approximately 71% of exporters and 53% of MNEs also import. These findings are consistent with evidence in a wide range of other countries (see e.g. Bernard et al., 2012; Mayer and Ottaviano, 2008; World Trade Organization, 2008).

Table 1 reports the means of our variables for the total estimation sample and split according to international activity. In the total estimation sample, real firm output, labor, materials and the Solow residual or conventional TFP measure have been stable over the considered period while capital has decreased at an average annual growth rate of 4.3%. On average, firm age equals 45 years, 35% of total employees are non-production workers and the price-cost margin amounts to 22%. Consistent with previous studies, our data reveal that exporters are systematically different from non-exporters. Among manufacturing firms, exporters pay higher wages, are larger, older, more capital-intensive, employ more non-production workers and are more productive. Table 1 also reveals that MNEs show the same performance differences as exporters.

Table A.3 in Appendix confirms these observations by summarizing the average percent difference for a particular characteristic between either exporters and non-exporters, or between MNEs and non-MNEs. The set of characteristics include the logarithms of firm size (employment), value added per worker, TFP, average wages, capital per worker, share of non-production workers and price-cost markups. The firm-year varying TFP and markup estimates are obtained by estimating translog production functions separately for each of our 15 industries. In order to ensure that the strict monotonicity assumption between productivity and intermediate inputs holds, we follow e.g. De Loecker and Warzynski (2012) and Ahsan and Mitra (2014) by ruling out inordinately high markups in the remainder of our empirical analysis.[16]

All results in column (1) of Table A.3 are from bivariate OLS regressions of a firm characteristic on a dummy variable indicating either a firm's export status or a firm's MNE status. Column (2) includes industry fixed effects and the logarithm of firm size as additional controls. Column (1) shows that there are substantial mean differences between exporters and non-exporters, and between MNEs and non-MNEs. As export/MNE participation is correlated with industry characteristics and firm size, the inclusion of industry fixed effects and firm size in column (2) reduces the magnitude of these coefficients. Exporters remain different from non-exporters even within the same disaggregated industry: exporters are more productive by 13% for value added per worker and by 2.0 % for total factor productivity, they pay higher wages by approximately 9% and are relatively more capital- and skill-intensive than non-exporters by approximately 7% and 30%, respectively. MNEs exhibit similar performance differences as exporters. One difference, though, is that there does not seem to be significant markup differences between exporters and non-exporters within the same industry whereas markups appear to be approximately 6% lower in MNEs. The former finding seems to be driven by correlations between firm observables and a firm's export status which are not controlled for in the bivariate OLS regression model. If we control for a richer set of firm observables as well as industry and time fixed effects, we observe a positive correlation between export status and markups (see infra, in particular Table 4). As hypothesized in Section 2, the latter could be explained through strategies of dumping and transfer pricing exerting negative effects on markups of MNEs, despite the observed positive productivity differential between MNEs and non-MNEs. Table 1 in the online supplementary material illustrates large variation in mean TFP and markup differences across industries.

6. Firm heterogeneity in regimes of competitiveness

Based on the estimates of μ_{it} and ψ_{it}, we obtain firm-year varying product market settings, labor market settings and regimes. We first examined firm-level persistence in the type of competition prevailing in product and labor markets and, hence, in the regime of competitiveness by investigating one-year transition probability rates across respective states over the period, where the states are defined as {PC,IC} in the case of PMS, {PR,EB,MO} in the case of LMS and {PC-PR,IC-PR,PC-EB,IC-EB,PC-MO,IC-MO} in the case of R. At the overall level, we find rather strong persistence in types of competitiveness as we observe the highest values on the diagonal for each regime. In particular, the fraction of firms remaining in their initial state ranges between 70% (PC-PR) and 93% (PC-MO). However, firm-year transitions appear to be important and the degree of persistence in regimes varies considerably across industries.[17]

We then determined the firm-specific PMS, LMS and regime by retaining the relevant type (PMS/LMS/R) that occurs most frequently in

[14] According to the website of the Ministry of Economy, Trade and Industry, the number of firms surveyed in manufacturing was 15,007 in 2012, with 12,891 firms responding (response rate = 85.9%). Only selecting firms that survive at least two consecutive years, which is a necessary condition for our estimation procedure, causes the decline in our sample size.

[15] If foreign-owned firms also have foreign affiliates outside Japan, they are not classified as FDI firms but as foreign-owned firms. In the BSJBSA, a Japanese foreign affiliate is defined as an affiliate with a capital share of more than 20%.

[16] In particular, we trimmed the parameter estimates of μ_{it} and gap_{Nit} at the 1st and 99th percentiles of the respective industry-year distributions to remove outliers.

[17] For example, in transport equipment, only 14% of firms characterized by PC-PR stay in their initial state while in iron and steel, this holds for as much as 96% of firms typified by PC-MO. These detailed results are not reported but available upon request.

Table 1
Descriptive statistics: Total estimation sample, and by export and MNE status, 1994-2012

Mean	Total	Exporters	Non-exporters	MNEs	Non-MNEs
Real firm output growth Δq_{it}	−0.004	0.001	−0.007	0.001	−0.006
Labor growth rate Δn_{it}	−0.010	−0.007	−0.011	−0.006	−0.010
Material growth rate Δm_{it}	−0.012	−0.009	−0.014	−0.008	−0.013
Capital growth rate Δk_{it}	−0.043	−0.041	−0.044	−0.043	−0.043
Labor share in nominal sales s_{Nit}	0.197	0.196	0.198	0.180	0.202
Material share in nominal sales s_{Mit}	0.582	0.592	0.578	0.614	0.573
$1 - s_{Nit} - s_{Mit}$	0.221	0.212	0.225	0.206	0.225
Average wage W_{it}	5.224	5.915	4.914	6.019	4.992
Number of workers N_{it}	433	873	236	1,208	207
Age	45	49	43	52	43
Exporter dummy EXP_{it}	0.310	1.000	0.000	0.758	0.179
Importer dummy IMP_{it}	0.270	0.645	0.101	0.660	0.156
MNE dummy MNE_{it}	0.226	0.552	0.079	1.000	0.000
Export-sales ratio	0.032	0.105	0.000	0.097	0.014
Herfindahl-Hirschman Index HHI_{Jt}	0.070	0.072	0.069	0.074	0.069
Capital intensity	1.617	1.733	1.565	1.817	1.559
Share of non-production workers	0.348	0.398	0.325	0.397	0.333
Labor productivity	32.580	36.273	30.920	39.496	30.564
SR_{it}	0.014	0.016	0.013	0.016	0.014
N	64,481	19,998	44,483	14,557	49,924

Note: $SR_{it} = \Delta q_{it} - s_{Nit}\Delta n_{it} - s_{Mit}\Delta m_{it} - (1 - s_{Nit} - s_{Mit})\Delta k_{it}$.

Table 2
Probability of being characterized by PMS = IC and LMS = {EB,MO} - Probit estimation.

	Specification 1 (baseline)			Specification 2		
	$\Pr(\mathrm{PMS=IC}\mid\mathbf{x})$[a] *dF/dx*	$\Pr(\mathrm{LMS=EB}\mid\mathbf{x})$[b] *dF/dx*	$\Pr(\mathrm{LMS=MO}\mid\mathbf{x})$[b] *dF/dx*	$\Pr(\mathrm{PMS=IC}\mid\mathbf{x})$[a] *dF/dx*	$\Pr(\mathrm{LMS=EB}\mid\mathbf{x})$[b] *dF/dx*	$\Pr(\mathrm{LMS=MO}\mid\mathbf{x})$[b] *dF/dx*
Exporter dummy (EXP)	0.011	0.042***	−0.028***	0.014**	0.037***	−0.024***
	(0.007)	(0.013)	(0.007)	(0.006)	(0.011)	(0.005)
MNE dummy (MNE)	−0.030***	−0.047***	0.013	−0.023***	−0.058***	0.020***
	(0.010)	(0.018)	(0.010)	(0.005)	(0.012)	(0.008)
EXP × MNE	0.011	−0.021	0.013			
	(0.012)	(0.021)	(0.012)			
TFP	−0.020***	−0.017***	0.017***	−0.020***	−0.017***	0.017***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.002)
Herfindahl-Hirschman index	0.131	0.420**	−0.286**	0.129	0.424**	−0.289**
	(0.138)	(0.193)	(0.142)	(0.138)	(0.193)	(0.142)
Size	−0.034***	−0.048***	0.021***	−0.034***	−0.048***	0.021***
	(0.003)	(0.005)	(0.003)	(0.003)	(0.005)	(0.003)
Age	0.0002	0.0017***	−0.0007***	0.0001	0.0016***	−0.0007***
	(0.0001)	(0.0003)	(0.0002)	(0.0001)	(0.0002)	(0.0001)
Share of non-production workers	−0.053***	−0.076***	0.030**	−0.053***	−0.076***	0.030**
	(0.012)	(0.017)	(0.012)	(0.012)	(0.017)	(0.011)
Time dummies	yes	yes	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes	yes	yes
Log likelihood	−16,575.3	−45,580.7		−16,576.8	−45,583.8	
Pseudo R^2	0.539			0.539		
N	64,481	64,481		64,481	64,481	

Notes: Significance level of ***1%, **5%, *10%. Bootstrapped standard errors (50 replications).
[a] Marginal effects of univariate probit model.
[b] Marginal effects of bivariate probit model.

order to examine the link between the internationalization status of firms and the type of product and labor market competition in a descriptive way. Table A.4 in Appendix presents the percentage of firms belonging to each of the six regimes of competitiveness for different subsets of firms. Among all manufacturing firms, about 25% are characterized by perfect competition and 75% by imperfect competition in the product market. The dominant labor market setting is efficient bargaining (EB; 42% of the firms), followed by perfect competition/right-to-manage bargaining (PR; 30% of the firms) and monopsony (MO; 28% of the firms). As such, the predominant regimes are IC-EB (42% of the firms), IC-PR (18% of the firms) and IC-MO (15% of the firms).

Table 2 in the online supplementary material shows considerable heterogeneity in regimes across and within manufacturing industries. Given that our data comprise a set of heterogeneous industries, such heterogeneity could be driven by product differentiation across firms and by the process of servitization, since servitization amounts to providing packages of goods and services, which is a way of increasing product differentiation.[18]

Let us now focus on the prevalence of regimes across firms that differ in terms of international activities. Comparing firms that differ according to export status reveals that a larger fraction of exporters are

[18] As shown by De Loecker et al. (2016), firms charge lower markups on products that are farther from their core competency (main product), consistent with heterogeneous models of multi-product firms such as, e.g., Mayer et al. (2014). Theoretical work on the provision of good-services bundles include, e.g., Breinlich et al. (2014), Lee et al. (2016) and Blanchard et al. (2017). The former and latter also assess empirically the determinants of firm servitization.

characterized by PMS = IC (79% of exporters compared to 67% of non-exporters). Exporters are dominantly characterized by efficient bargaining (46% of exporting firms) and far less so by monopsony (only 22% of exporting firms) whereas the three labor market settings are more evenly distributed among non-exporters. As such, market power on the supply side seems to be predominantly responsible for distorting factor prices among exporters. The distribution of product and labor market settings and regimes across MNEs (non-MNEs) is very similar to the one across exporters (non-exporters).

The descriptive analysis presented above does not give a detailed picture on potential differences in firms' regimes across modes of internationalization for two main reasons. First, it does not exploit time variation in a firm's product and labor market setting. Second, it does not take into account correlations between firm observables and a firm's export/MNE status which could partially account for differences between exporters and non-exporters and/or between MNEs and non-MNEs. Indeed, firm i's product market setting at time t might depend on its engagement in international activities, other observable characteristics as well as unobservable factors ϵ such as managerial ability. To allow the marginal effect of being an exporter (MNE) to depend on MNE (EXP) status, we include an interaction term which is the product of the binary variables export status and MNE status. Suppressing firm and time subscripts (i and t, respectively) for simplicity, we thus have:

$$PMS^* = \beta_0 + \beta_1 \text{EXP} + \beta_2 \text{MNE} + \beta_3 (\text{EXP} \times \text{MNE}) + \beta_4 \hat{\omega} + \mathbf{z}\beta_z + \epsilon \qquad (36)$$

with EXP export status, MNE MNE status and $\hat{\omega}$ estimated TFP.[19] The vector $\mathbf{z}$ comprises firm-year varying variables such as a firm's size (number of workers), age and the share of non-production workers; the Herfindahl-Hirschman index, a set of time dummies and industry fixed effects. In order to investigate the link between the internationalization status of firms and the likelihood of being characterized by imperfect competition in the product market, we specify the following probit model:

$$\Pr(\text{PMS} = \text{IC} | \mathbf{x}) = \Phi(\mathbf{x}\beta) \qquad (37)$$

The baseline category is PMS=PC and the vector $\mathbf{x}$ includes the regressors specified in Eq. (36).

Whether market power in firm i in period t is consolidated on either the supply side or the demand side of labor might be influenced by common observable as well as unobservable factors such as a firm's corporate culture. To take into account the full covariance structure and to investigate the link between the internationalization status of firms and the likelihood of being characterized by either efficient bargaining or monopsony, we specify the following two-equation multivariate probit model:

$$\begin{aligned} LMS_m^* &= \mathbf{x}_m \beta_m + \epsilon_m, \qquad m = 1, 2 \\ LMS_m &= I(LMS_m^* > 0), \qquad m = 1, 2 \\ \boldsymbol{\epsilon} &= (\epsilon_1, \epsilon_2)' \sim N(0, \Sigma) \end{aligned} \qquad (38)$$

where $LMS_1 = \Pr(\text{LMS=EB}|\mathbf{x})$ and $LMS_2 = \Pr(\text{LMS=MO}|\mathbf{x})$. The baseline category is LMS = PR. We include the same regressors as in the univariate probit model (Eq. (37)).

Table 2 presents the marginal effect of the regressors in the univariate and the multivariate probit models. As such, columns 1 and 4 report how much the (conditional) probability of being characterized by PMS = IC changes when the value of a regressor changes, holding all other regressors constant whereas columns 2-3 and 5-6 show how much the likelihood of being characterized by either LMS = EB or LMS = MO changes. Accounting for the use of a generated regressor, we employ block bootstrapping for statistical inference.

We consider two specifications. The baseline specification (specification 1) permits testing the hypothesis that the effect of serving the foreign market through exporting (FDI) is the same for MNEs and non-MNEs (exporters and non-exporters) whereas specification 2 does not include the interacted regressor. The parameters of interest are β_1, β_2 and β_3.

The estimates of the baseline specification indicate that the coefficient on the interaction term (EXP×MNE) is not significantly different from zero in both the univariate and bivariate probit models. Therefore, we rely on the estimates of specification 2 and focus the discussion on our variables of interest.

Being an exporter increases the likelihood of being characterized by imperfect competition in the product market by 1.4 percentage points, even after controlling for productivity differences. This result is consistent with the conjecture that exporters have a higher probability of operating in an imperfectly competitive product market setting relative to non-exporters (conjecture 1a in Section 2.1). This finding could be explained by quality differences or differences in demand elasticities and income across domestic and export markets, generating markup differences between exporters and non-exporters. Conjecture 3a, postulating that exporters have a higher probability (relative to non-exporters) to operate in a collective bargaining labor market setting, is confirmed. More precisely, we find that being an exporter increases the likelihood of being characterized by LMS = EB by 3.7 percentage points whereas it decreases the likelihood of being characterized by LMS = MO by 2.4 percentage points. Put differently, exporting firms are more likely to share rents based on the bargaining power of workers, but less likely to share rents based on the elasticity of the labor supply curve facing an individual employer. This former rent-sharing mechanism could be explained by the fact that exporters, which charge higher markups and realize higher rents, are willing to share part of these rents with their workers according to a surplus-sharing rule.

When focusing on correlations between being an MNE and the likelihood of being characterized by PMS = IC, LMS = EB or LMS = MO, respectively, we get a completely different picture. We interpret this as evidence of clear differences in behavior between firms that serve the foreign market either through exporting or through FDI. Controlling for differences in productivity, we find that being an MNE decreases the probability of being characterized by imperfect competition in the product market by 2.3 percentage points. This result, which is consistent with the conjecture that multinationals are less likely to operate in an imperfectly competitive product market setting (conjecture 1b in Section 2.1), can be explained by strategies of dumping and transfer pricing exerting opposite (that is, negative) effects on markups than channels of quality and demand elasticity differences. Based on empirical evidence on multinationals perceiving higher labor demand elasticities and engaging more in international rent sharing if affiliates are located in low-tax countries, we hypothesized that MNEs are less likely to operate in a (closed-economy) collective bargaining labor market setting (conjecture 3b in Section 2.1). We find support for this conjecture. More precisely, being a firm that serves the foreign market through FDI decreases the likelihood of being characterized by LMS=EB by 5.8 percentage points whereas it increases the likelihood of being characterized by LMS = MO by 2.0 percentage points. The latter finding is compatible with MNEs having considerable monopsony power in the labor market due to, e.g., high intra-firm labor replacement in such firms.

Since, to the best of our knowledge, existing theories and empirical analyses on the relationship between internationalization status and the nature of competition in product *and* labor markets are nonexistent, we are not in a position to postulate conjectures in terms of the relationship between internationalization status and the likelihood of being characterized by a particular regime R = { PC-PR,IC-PR,PC-EB,IC-EB,PC-MO,IC-MO}. However, based on our "separate" conjectures (see Section 2), we tested the following "joint" conjectures:

Joint conjecture 1: Exporters are likely to operate in an imperfectly competitive product market setting and a collective bargaining labor market setting.

[19] Since productivity is inherently a relative concept, we normalize the firm-year productivity-level estimates in the remaining regression models.

Joint conjecture 2: Multinationals are less likely to operate in an imperfectly competitive product market setting and a collective bargaining labor market setting.

The results, that we obtain from estimating a multinomial logit model, support both joint conjectures. More precisely, we find that being an exporter increases the probability of being characterized by R = IC-EB (rather than being characterized by one of the five other regimes) by 4.6 percentage points (relative to being a non-exporter) whereas the probability of being characterized by R=IC-EB is on average 5.6 percentage points lower for multinationals than for non-MNEs with the same characteristics.[20]

Robustness checks. We performed two robustness checks.[21] First, given that our theoretical structural productivity model applies more to domestic firms deciding to export and/or to invest abroad than to foreign-owned firms operating in Japan, we checked the sensitivity of our main results with respect to excluding firms engaging in inward FDI. Since the share of foreign-owned firms is only about one percent, our main results are robust to the exclusion of foreign-owned firms.

Second, we checked the sensitivity of our main results with respect to excluding firms that switch internationalization status. Comparing exporters to non-exporters, we observe that 78.5% of firms in our sample are non-switchers, among which 17.1% are non-switching exporters and 61.4% are non-switching non-exporters. 54% of firms that change export status only switch once and 28% switch twice. Comparing MNEs to non-MNEs, we observe that 84% of firms are non-switchers, among which 11.8% are non-switching MNEs and 72.2% are non-switching non-MNEs. 68% of firms that change MNE status only switch once and 22% switch twice. If we take into account potential selection bias arising from only retaining non-switching firms, where we model $\Pr(\text{non-switching}=1|\mathbf{x}) = \Phi(\mathbf{x}\beta)$ with the vector $\mathbf{x}$ including the 1-year lag of TFP $\left(\widehat{\omega}_{it-1}\right)$ and the capital stock $\left(k_{it-1}\right)$, our main results are confirmed.[22] If we do not take such selectivity into account, conjecture 1a is no longer confirmed whereas we continue to find support for conjectures 1b, 3a and 3b. We put forward two reasons for this finding. First, it may be due to the reduced sample size because we lose 35% of observations (27% of firms) by discarding switching firms. Second, the behavior of continuing exporters/MNEs might be different from future exiting exporters/MNEs. Evidence for the latter explanation is given by Tan et al. (2016), who find that continuing exporters set a lower price than future exiting firms, which is compatible with our result. To address this issue further, we need more detailed data such as firm-level prices, which are not available in our sample.

7. Market imperfections and export/MNE status

To get a first insight into the link between the internationalization type of firms and the degree of product and labor market imperfections, Table 3 reports median values of estimated parameters – markups (μ), labor market imperfections (workers' bargaining power ϕ or the wage elasticity of a firm's labor supply curve ε_W^N) and productivity (ω)– for subsets of firms within a particular regime. We define subsets of firms based on their engagement in international activities.

Let us focus the discussion on the regimes characterized by imperfect competition in product as well as labor markets. Conditional on being characterized by R = IC-EB, we find that the median value of markup estimates is lower for exporters relative to non-exporters (1.42 versus 1.55). When comparing MNEs to non-MNEs, this discrepancy is larger (1.35 versus 1.56). In addition, workers in MNEs seem to have a slightly lower bargaining power than in non-MNEs (median value of 0.27 for the former and 0.30 for the latter).

Interestingly, the opposite picture appears when comparing subsets of firms, conditional on being characterized by R = IC-MO. Irrespective of whether firms serve the foreign market either through exporting or through FDI, we find that firms that engage in international activities seem to have larger market power in both product and labor markets. More specifically, the median value of markups is 1.21 for exporters compared to 1.16 for non-exporters and the median value of an individual firm's labor supply elasticity is 1.48 for exporters compared to 1.72 for non-exporters, implying that exporters have larger wage-setting power. On the labor side, the discrepancy is even larger when comparing MNEs to non-MNEs (median value of ε_W^N is 1.32 for the former and 1.74 for the latter).

The observed differences in the degree of market imperfection parameters discussed so far could, however, partly been driven by correlations between firm observables and a firm's export/MNE status. To address this concern, we examine the links between the internationalization status of firms and the degree of market imperfections within a regression framework. We estimate the average effect of export/MNE status (and other independent variables) on the degree of product and labor market imperfections in a 'representative enterprise'. As such, we define the following regression models:[23]

$$\ln \widehat{\mu}_{it+1} = \alpha_0 + \alpha_1 \text{EXP}_{it} + \alpha_2 \text{MNE}_{it} + \alpha_3 (\text{EXP} \times \text{MNE})_{it} + \alpha_4 \widehat{\omega}_{it} + \alpha_5 \text{IMR}_{it} + \mathbf{z}_{it}\alpha_z + \zeta_{it} \tag{39}$$

$$\ln\left(\frac{\widehat{\phi}_{it+1}}{1-\widehat{\phi}_{it+1}}\right) = \alpha_0 + \alpha_1 \text{EXP}_{it} + \alpha_2 \text{MNE}_{it} + \alpha_3 (\text{EXP} \times \text{MNE})_{it} + \alpha_4 \widehat{\omega}_{it} + \alpha_5 \text{IMR}_{it} + \mathbf{z}_{it}\alpha_z + \zeta_{it} \tag{40}$$

$$\ln(\widehat{\varepsilon}_W^N)_{it+1} = \alpha_0 + \alpha_1 \text{EXP}_{it} + \alpha_2 \text{MNE}_{it} + \alpha_3 (\text{EXP} \times \text{MNE})_{it} + \alpha_4 \widehat{\omega}_{it} + \alpha_5 \text{IMR}_{it} + \mathbf{z}_{it}\alpha_z + \zeta_{it} \tag{41}$$

with IMR the inverse Mills ratio from the respective probit model, which we include to account for selection bias, and the vector $\mathbf{z}$ comprising the same regressors as in Section 6. Because the effect of our regressors of interest might not be instantaneous, we use the one-year lead of the dependent variables. To deal with generated regressands and regressors, we use block bootstrapping for statistical inference. As the share of rents captured by the workers (ϕ) lies within the [0,1]-range, we use a logit transformation to model the bargaining power of workers.

Table 4 presents the average effect of the regressors in the three regression models. Similar to the probit models specified above, we consider two specifications. The baseline specification (specification 1) permits testing the hypothesis that the effect of serving the foreign market through exporting (FDI) is the same for MNEs and non-MNEs (exporters and non-exporters) whereas specification 2 does not include the interacted regressor. The parameters of interest are α_1, α_2 and α_3.

The estimates of the baseline specification indicate that the coefficient on the interaction term (EXP×MNE) is not significantly different from zero in the three regression models. Therefore, we rely on the estimates of specification 2 and focus on our regressors of interest. Conditional on being characterized by PMS = IC, we observe a significantly

[20] These results are not reported but available upon request.

[21] The results of these robustness checks are not reported but available upon request.

[22] As lagged productivity is included in the selection equation, we excluded this regressor in the univariate and the multivariate probit models which model the probability of being characterized by PMS = IC and LMS = {EB,MO} and included the inverse Mills ratio from the probit model on the probability of being a non-switching firm.

[23] One could argue that observable firm characteristics might correlate with unobservable firm characteristics such as managerial ability or workplace environment, which would favor applying a fixed effects estimator. However, this would render the interpretation of the effect of e.g. being an exporter difficult. This is because when firm fixed effects are included, identification originates from changes in export status, implying that the benchmark would also comprise continuing exporters.

Table 3
Three-dimensional firm heterogeneity: Markups (μ), labor market imperfections (workers' bargaining power ϕ or the wage elasticity of a firm's labor supply curve ε_W^N), and productivity (ω)

R = PC-PR	μ	ψ	ω			R = IC-PR	μ	ψ	ω		
All firms	0.948	0.389	−0.256			All firms	1.256	0.048	0.003		
Exporters	0.902	0.388	0.036			Exporters	1.235	0.033	−0.120		
Non-exporters	0.965	0.390	−0.380			Non-exporters	1.262	0.053	0.039		
MNEs	0.914	0.345	0.205			MNEs	1.214	0.033	−0.141		
Non-MNEs	0.955	0.401	−0.385			Non-MNEs	1.266	0.051	0.033		
R = PC-EB	μ	ψ	ω	γ	ϕ	R = IC-EB	μ	ψ	ω	γ	ϕ
All firms	1.020	0.758	−0.047	1.243	0.555	All firms	1.518	0.713	−0.073	0.408	0.290
Exporters	0.989	0.738	0.077	1.207	0.543	Exporters	1.419	0.599	0.054	0.393	0.282
Non-exporters	1.030	0.767	−0.108	1.246	0.562	Non-exporters	1.554	0.769	−0.117	0.414	0.293
MNEs	0.985	0.730	0.183	1.149	0.546	MNEs	1.355	0.540	0.137	0.363	0.266
Non-MNEs	1.029	0.763	−0.111	1.276	0.556	Non-MNEs	1.560	0.769	−0.122	0.420	0.296
R = PC-MO	μ	ψ	ω	β	ε_W^N	R = IC-MO	μ	ψ	ω	β	ε_W^N
All firms	0.863	−1.713	0.159	0.332	0.542	All firms	1.175	−0.749	0.089	0.620	1.633
Exporters	0.858	−1.747	0.186	0.325	0.508	Exporters	1.214	−0.856	0.030	0.597	1.479
Non-exporters	0.869	−1.668	0.134	0.340	0.579	Non-exporters	1.156	−0.692	0.116	0.633	1.723
MNEs	0.834	−1.979	0.216	0.296	0.463	MNEs	1.201	−0.964	0.034	0.569	1.322
Non-MNEs	0.877	−1.595	0.129	0.354	0.593	Non-MNEs	1.167	−0.696	0.105	0.635	1.737
All regimes	μ	ψ	ω								
All firms	1.230	0.248	−0.031								
Exporters	1.181	0.102	0.048								
Non-exporters	1.254	0.299	−0.064								
MNEs	1.166	0.091	0.104								
Non-MNEs	1.252	0.288	−0.067								

Note: Median values of the relevant parameter estimates are reported.

Table 4
Mean regression results (OLS).

	Specification 1 (baseline)			Specification 2		
Dependent variable	$\ln \widehat{\mu}_{it+1}$	$\ln\left(\frac{\widehat{\phi}_{it+1}}{1-\widehat{\phi}_{it+1}}\right)$	$\ln(\widehat{\varepsilon}_W^N)_{it+1}$	$\ln \widehat{\mu}_{it+1}$	$\ln\left(\frac{\widehat{\phi}_{it+1}}{1-\widehat{\phi}_{it+1}}\right)$	$\ln(\widehat{\varepsilon}_W^N)_{it+1}$
Exporter dummy (EXP)	0.030***	0.046	0.209***	0.027***	0.080*	0.201***
	(0.010)	(0.050)	(0.036)	(0.008)	(0.044)	(0.032)
MNE dummy (MNE)	−0.034***	−0.108**	−0.054	−0.040***	−0.124**	−0.073***
	(0.011)	(0.055)	(0.049)	(0.009)	(0.054)	(0.028)
EXP × MNE	−0.010	0.026	−0.032			
	(0.013)	(0.060)	(0.059)			
TFP	0.001	−0.049***	−0.301***	0.001	−0.052***	−0.302***
	(0.005)	(0.018)	(0.016)	(0.005)	(0.016)	(0.016)
Herfindahl–Hirschman index	0.433*	−0.633	6.957***	0.434*	−0.618	6.965***
	(0.244)	(0.553)	(0.753)	(0.244)	(0.727)	(0.741)
Size	−0.023***	−0.045	−0.343***	−0.024***	−0.059	−0.343***
	(0.004)	(0.041)	(0.017)	(0.004)	(0.044)	(0.017)
Age	0.0004**	−0.0006	0.004***	0.0004**	−0.0006	0.004***
	(0.0002)	(0.002)	(0.001)	(0.0002)	(0.002)	(0.001)
Share of non-production workers	−0.090***	0.274***	−0.166***	−0.090***	0.218***	−0.166***
	(0.016)	(0.079)	(0.053)	(0.016)	(0.073)	(0.052)
Inverse Mills ratio	0.101***	0.065	−0.925***	0.102***	0.216	−0.927***
	(0.032)	(0.360)	(0.166)	(0.032)	(0.375)	(0.163)
Time dummies	yes	yes	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes	yes	yes
Adjusted R^2	0.146	0.268	0.493	0.146	0.268	0.493
N	42,302	23,243	16,207	42,302	23,243	16,207

Notes: Significance level of ***1%, **5%, *10%. Standard errors are heteroskedasticity consistent and clustered by enterprises.

positive correlation between export status and product market power ($\widehat{\mu}$), which confirms conjecture 2a (see Section 2.1). Controlling for productivity differences, quality differences and differences in demand elasticities and income across domestic and export markets could drive this finding. Conditional on being characterized by LMS = EB, we find a significantly positive correlation between export status and labor market power consolidated on the labor supply side ($\widehat{\phi}$), which provides support for conjecture 4a. This might be interpreted as exporters being willing to share a larger part of increased rents with their workers. Conditional on being characterized by LMS = MO, we detect a significantly positive correlation between export status and the wage elasticity of a firm's labor supply curve, implying that exporters are less able to exploit wage-setting power.

Based on hypothesis testing, we clearly reject the equality of the estimated coefficients on export status and MNE status in each of the three regression models. Confirming conjectures 2b and 4b, we find a significantly negative correlation between MNE status and either product market power or workers' bargaining power. The former finding could be explained by strategies of dumping and transfer pricing having a negative impact on markups of MNEs. The latter again confirms that (the threat of) relocating plants from home to foreign countries might flatten the labor demand curve and shift bargaining power over rent distribution from labor towards capital in MNEs. Our results also indicate that MNEs seem to have more wage-setting power, which could be explained by high intra-firm labor replacement in such firms.

In Table 4 in the online supplement, we show considerable cross-industry variation in the average effects of internationalization status for each regression model (Eqs. (39)-(41)). Given that we acknowledge that firms are heterogeneous, one could argue that the exclusive focus on mean effects might be misleading. The online supplementary material indeed confirms heterogeneous returns to being an exporter/MNE within an industry and reveals cross-industry differences.

Robustness checks. Similar to our analysis relating a firm's internationalization status to the type of competition prevailing in product and labor markets, we checked the sensitivity of our main results with respect to excluding either firms engaging in inward FDI or firms switching internationalization status.[24] Our first robustness check confirms that our main results are robust to excluding foreign-owned firms operating in Japan. From our second robustness check, it follows that the marginal effects of export and MNE status on workers' bargaining power preserve their signs but turn to be insignificant if we do not account for selection bias arising from only considering non-switching firms. This would imply that conjecture 4a is no longer confirmed whereas we continue to find support for conjectures 2a, 2b and 4b. However, if we account for selection bias, all our main results are confirmed.

8. Conclusion

Do the type and degree of labor market imperfections vary across firms that differ in terms of internationalization? In spite of the growing importance of labor market imperfections in recent international trade theory, this question has not been answered so far. Microeconometric studies in the field have predominantly provided evidence of the well-established productivity premium of firms with international activities relative to firms serving only domestic markets and have recently focused on the underlying sources of this productivity advantage.

This paper examines the links between a firm's internationalization status and the type and degree of market imperfections in product and labor markets using an unbalanced panel of 7,458 manufacturing firms over the period 1994-2012 in Japan. Our contribution to the econometric literature on identifying market imperfections and the empirical international trade literature is twofold. First, we develop a framework for modelling heterogeneity across firms in terms of (i) product market power (price-cost markups), (ii) labor market imperfections (workers' bargaining power during worker-firm negotiations or a firm's degree of wage-setting power) and (iii) revenue productivity. Second, we apply this framework in order to examine whether pricing behavior in product and labor markets depends on a firm's internationalization status, while accounting for differences in revenue productivity. We consider two main forms of internationalization: exports and (predominantly outward) foreign direct investment. As such, we are able to improve our understanding of the wage determination process of firms that engage differently in international activities.

Based on available theories and existing empirical evidence, we derive conjectures about the relationships of interest, which are supported by our findings. We observe clear differences in behavior between firms that serve the foreign market either through exporting or through FDI. In particular, we find that being an exporter increases the likelihood of being characterized by imperfect competition in the product market. Exporting firms are more likely to share rents based on the bargaining power of workers, but less likely to share rents based on the elasticity of the labor supply curve facing an individual employer. In contrast, a firm's wage-setting power rather than workers' bargaining power appears to generate wage dispersion across firms engaging in FDI.

Engagement in international activities also matters for determining the order of magnitude of imperfections in product and labor markets. Controlling for differences in productivity, we find a positive correlation between export status and product market power (markups) as well as market power consolidated on the labor supply side (workers' bargaining power), whereas exporting firms seem less able to exploit wage-setting power. The opposite picture emerges for multinationals.

Our analysis can be pursued in several directions, either to provide causal evidence or to examine some new developments. First, one obvious research avenue is to establish the causal impact of trade/FDI liberalization on firms' market power in product and labor markets using actual liberalization episodes. Second, given that our study reveals considerable heterogeneity in regimes of competitiveness across firms that differ in terms of internationalization status within the same industry, it would be interesting to extend our productivity model to allow for multi-product firms and to examine the role of product differentiation and servitization in explaining such heterogeneity. Finally, acknowledging the important role of trade in intermediate inputs in today's international trade structure, another extension of our productivity model is to take into account imperfections in the intermediate input market. Conditional on having data on domestically purchased and imported material inputs, one could use such framework to interpret labor market imperfections as a source of contractual incompleteness and investigate their impact on sourcing decisions of multinationals.

Appendix

Table A.1
Panel structure: Number of participations.

# of participations	# obs.	%	# firms	%
2	1,074	1.7	1046	14.0
3	1,817	2.8	886	11.9
4	1,757	2.7	566	7.6
5	2,297	3.6	551	7.4
6	2,043	3.2	384	5.1
7	2,117	3.3	333	4.5
8	2,138	3.3	294	3.9
9	2,418	3.7	283	3.8
10	1,824	2.8	178	2.4
11	2,310	3.6	212	2.8
12	2,168	3.4	186	2.5
13	1,949	3.0	155	2.1
14	2,198	3.4	165	2.2
15	2,153	3.3	150	2.0
16	2,332	3.6	154	2.1
17	2,679	4.2	167	2.2
18	4,369	6.8	257	3.4
19	26,838	41.6	1,491	20.0
Total	64,481	100.0	7,458	100.0

[24] The results of these robustness checks are not reported but available upon request.

Table A.2
Repartition by industry, export and MNE status.

	# obs.	%	# firms	%	% of exporters	% of MNEs
Total	64,481	100.0	7,458	100.0	24.7	15.4
Food products and beverages	8,644	13.4	957	12.8	10.1	7.5
Textiles and wearing apparel	3,345	5.2	498	6.7	13.0	13.8
Wood, wooden products, and furniture	1,014	1.6	176	2.4	5.8	9.8
Pulp, paper and paper products	2,362	3.7	251	3.4	7.2	4.0
Publishing and printing	4,030	6.2	438	5.9	6.3	6.3
Chemicals	5,869	9.1	557	7.5	50.4	26.5
Petroleum and coal products	4,065	6.3	458	6.1	23.3	19.3
Non-metallic mineral products	3,101	4.8	377	5.1	18.3	11.1
Iron and steel	2,213	3.4	240	3.2	23.1	15.6
Non-ferrous metals	1,659	2.6	183	2.5	31.5	18.5
Fabricated metal products	5,164	8.0	609	8.2	18.0	10.7
Machinery	7,005	10.9	797	10.7	43.8	20.3
Electrical machinery	6,054	9.4	820	11.0	29.0	16.5
Transport equipment	6,411	9.9	670	9.0	29.0	22.4
Other manufacturing	3,545	5.5	427	5.7	41.6	21.2
Exporters	19,998	31.0	1,859	24.9	100.0	45.5
Non-exporters	44,483	69.0	5,599	75.1	0.0	5.7
MNEs	14,557	22.6	1,163	15.6	72.7	100.0
Non-MNEs	49,924	77.4	6,295	84.4	16.1	0.0

Table A.3
Exporter and MNE premia.

	Exporters		MNEs	
	(1)	(2)	(1)	(2)
ln (employment$_{it}$)	0.780***	–	1.113***	–
ln (value added per worker$_{it}$)	0.273***	0.129***	0.278***	0.122***
ln (TFP$_{it}$) = $\widehat{\omega}_{it}$	0.139***	0.020***	0.111***	0.029***
ln (wage$_{it}$)	0.196***	0.085***	0.192***	0.066***
ln (capital per worker$_{it}$)	0.168***	0.069***	0.257***	0.097***
ln (share of non-production workers$_{it}$)	0.306***	0.300***	0.250***	0.255***
ln (markup$_{it}$) = ln $\widehat{\mu}_{it}$	−0.099***	−0.011	−0.121***	−0.059***
Additional covariates				
Industry fixed effects	No	Yes	No	Yes
ln (employment)$_{it}$	No	Yes	No	Yes

Notes: ***: Significance level of 1%. Each row summarizes the average percent difference for a particular characteristic between either exporters and non-exporters, or MNEs and non-MNEs . All results in column (1) are from bivariate OLS regressions of a firm characteristic on a dummy variable indicating either a firm's export status or a firm's MNE status. Colum (2) includes industry fixed effects and ln (employment$_{it}$) as additional controls.

Table A.4
Percentage of firms in each regime: Total and by export/MNE status.

	# obs.	# firms	PC-PR	IC-PR	PC-EB	IC-EB	PC-MO	IC-MO
Total	64,481	7,458	12.0	17.9	1.6	42.0	11.0	15.4
Exporters	19,998	1,859	11.4	19.7	1.4	45.0	8.1	14.4
Non-exporters	44,483	5,599	12.8	13.5	2.0	36.1	18.2	17.5
MNEs	14,557	1,163	11.7	18.2	1.6	44.1	9.5	14.9
Non-MNEs	49,924	6,295	13.7	16.8	1.6	34.1	16.9	17.0

Notes: $R \in \mathfrak{R}$ = {PC-PR,IC-PR,PC-EB,IC-EB,PC-MO,IC-MO}, with PMS ∈ {PC,IC} and LMS ∈ {PR,EB,MO}. PC refers to perfect competition, IC to imperfection competition, PR to perfect competition/right-to-manage bargaining, EB to efficient bargaining and MO to monopsony.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.labeco.2018.05.004.

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